

**A New Species of *Goniozus* Foerster from India (Hymenoptera:
Bethyidae) used in biological control of *Diaphania indica* (Saunders)
(Lepidoptera: Pyralidae).**

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Abstract.—*Goniozus sensorius* NEW SPECIES is described. The wasp parasitizes the Pyralid *Diaphania indica* (Saunders) in Chingleput District, Madras, India.

INTRODUCTION

Bethylids submitted for identification to Dr. Z. Boucek, CIE, by Mr. Clement Peter, Frederick Institute of Plant Protection, Chingleput District, Madras, India, represented a species of *Goniozus*. Boucek suggested that Mr. Peter send the material to me for study. The specimens from India represent another undescribed species of *Goniozus*. A name is made available for the wasp here so an account of its biology can be published by Mr. Peter in connection with his research.

***Goniozus sensorius* Gordh, NEW SPECIES**

Female.—3.15 mm long (Holotype). Body black; antenna yellow with apical three segments very faintly infuscated in some plays of light. Mandible concolorous with antennal scape. Legs reddish brown with anterior face of forecoxa and forefemur somewhat darker; tarsal claws black. Wings hyaline; forewing veins pale colored, stigma blackish.

Head in dorsal (frontal) aspect about as long as wide with uniform, rather weak, reticulate microsculpture and numerous shallow, setigerous punctations (Fig. 02); setae along vertexal margin weakly (not strongly) recurved and not conspicuously larger than other setae on head (Fig. 01); vertexal margin acute. Shallow depression anterior of median ocellus ill-defined but apparent when specimen rotated in diffuse or concentrated light; lateral ocellus at vertexal margin. Fronto-clypeal median longitudinal carina acute (Fig. 01, FC), and projecting above ventral margin of compound eye (Fig. 02, FC). Scrobal impression rather shallow and short, with dorsal margin broadly rounded and not well defined. Head in lateral aspect (Fig. 01) not strongly prognathous (Fig. 06). Compound eye minutely and very sparsely setose; setae evident only at high magnification (Fig. 03, S). Mandibles symmetrical, each four toothed with uppermost tooth truncate, remaining teeth apically pointed, third tooth longest (Fig. 04). Antenna as illustrated (Fig. 08); flagellar segments apparently lacking multiporous plate sensilla (rhinaria, tyloids) under light microscopy, ro vestigial with SEM (Fig. 09, MPS); club apically somewhat truncate (Fig. 08). Maxillary palpus five-segmented; labial palpus three-segmented.

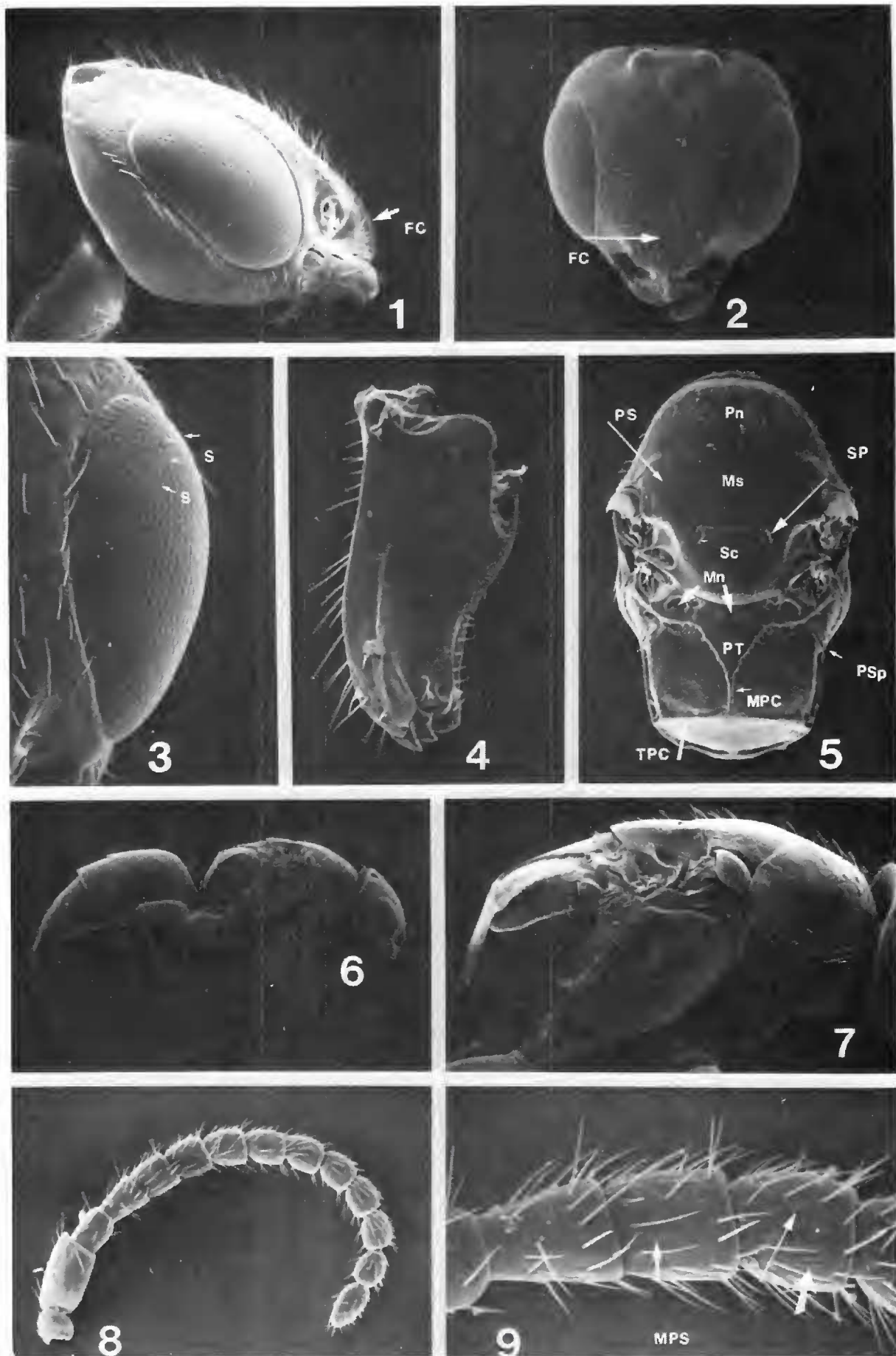


Figure 1. *Goniozus sensorius* n. sp., female head, lateral aspect (110X). (FC. Frontal Carina). Figure 2. *Goniozus sensorius* n. sp., female head, frontal aspect (94X). (FC. Frontal Carina). Figure 3. *Goniozus sensorius* n. sp., female compound eye, frontal aspect (180X). (S. Seta). Figure 4. *Goniozus sensorius* n. sp., female mandible, ventromedial aspect (320X). Figure 5. *Goniozus sensorius* n. sp., female mesosoma, dorsal aspect (66X). (Mn. Metanotum; MPC. Median Propodeal Carina. Ms. Mesoscutum; Pn. Pronotum; PT. Propodeal Triangle; PS. Parapsidal Suture; PSp. Parapsidal Spiracle; SP. Scutellar Pit; Sc. Scutellum; TPC. Transverse Propodeal Carina.) Figure 6. *Goniozus sensorius* n. sp., female mesosoma, lateral aspect (72X). Figure 7. *Goniozus sensorius* n. sp., female habitus, lateral aspect (26X). Figure 8. *Goniozus sensorius* n. sp., female antenna (130X). Figure 9. *Goniozus sensorius* n. sp., female antennal flagellar segments 1-3 (400X). (MPS. Multiporous Plate Sensilla).

Mesosoma in dorsal aspect (Fig. 05) with pronotum (Pn) moderately setose, weakly and uniformly reticulate except smooth along posteromedial margin. Mesoscutum (Ms) moderately setose (only sockets evident in micrograph) with sculpture less pronounced; parapsidal sutures complete but weakly developed (PS). Scutellum sparsely setose (only sockets evident in micrograph); polished, with very minutely and weakly reticulate sculpture between scutellar pits; scutellar pits (Fig. 05 SP) well developed along transscutal suture but transverse groove absent. Metanotum (Mn) with a few setae and weak reticulate sculpture in meson and well-developed pits in lateron. Anteromedial propodeal triangle large, polished and conspicuously elevated (Fig. 05 PT), continuing posteriad as a median carina (MPC) which reaches complete transverse carina (TPC) marking junction of dorsal and posterior faces; dorsal face predominantly reticulate; lateral face entirely reticulate (Fig. 07); posterior face reticulate with pattern evanescent medially. Propodeal spiracle exceedingly inconspicuous, obliquely slit-like, and positioned along anterolateral margin of propodeum (Fig. 05, PSp). Mesosoma in lateral aspect not conspicuously compressed (Figs. 06, 07); mesopleuron with conspicuous vestiture of pale setae along anterior surface (Fig. 07). Wings flat, not curved to form to the curvature of the metasomal dorsum; forewing with basal vein short and not forming an areolet.

Metasoma polished, weakly transversely reticulate along anterolateral margin of Terga II–V; respiratory spiracles on Terga II–VI; Terga III–IV with a few setae laterad; Tergum V with vestiture along posterior half; Tergum VI moderately setose. Sterna II–VI moderately setose with individual setae rather long; apical sternum conspicuously more setose than preceding sterna, when viewed in lateral aspect the setae are decidedly shorter than setae on other sterna and form an erect mat projecting from the integument.

Male.—2.22 mm long (Allotype) (Fig. 13). Similar to female in coloration and habitus. Taxonomically important details include: Head in dorsal aspect (Fig. 11) more transverse, sculpture and chaetotaxis similar to female, but ocelli allometrically (disproportionately) larger. Head in lateral aspect as illustrated (Fig. 10). Antenna (Figs. 19, 21, 23) similar in form to female antenna, with multiporous plate sensilla (Fig. 21 MPS) evanescent. Mandible shorter and wider than female mandible, but with similar sensilla (Fig. 12, third tooth broken).

Mesosoma (Figs. 13, 14) slightly shorter than female mesosoma. Scutellar and metanotal pits as female in shape, position and size (Fig. 16). Propodeal spiracles decidedly larger than female (Fig. 14 PSp). Pretarsal claws “bifid”, each with a subapical tine apically truncate (Figs. 27, 28).

Subgenital shield conspicuously setose and with a medial notch along the posterior margin (Figs. 29, 30). Genitalia (Figs. 31, 32) as illustrated.

ETYMOLOGY

The specific epithet, *sensorius*, refers to the curious atrophy of multiporous plate sensilla found on the flagellar segments of the antenna.

VARIATION

Female.—Body length ranges from 2.66–4.40 mm in the type-series. Specimens display variation in the coloration of the femora. Some specimens show a decidedly

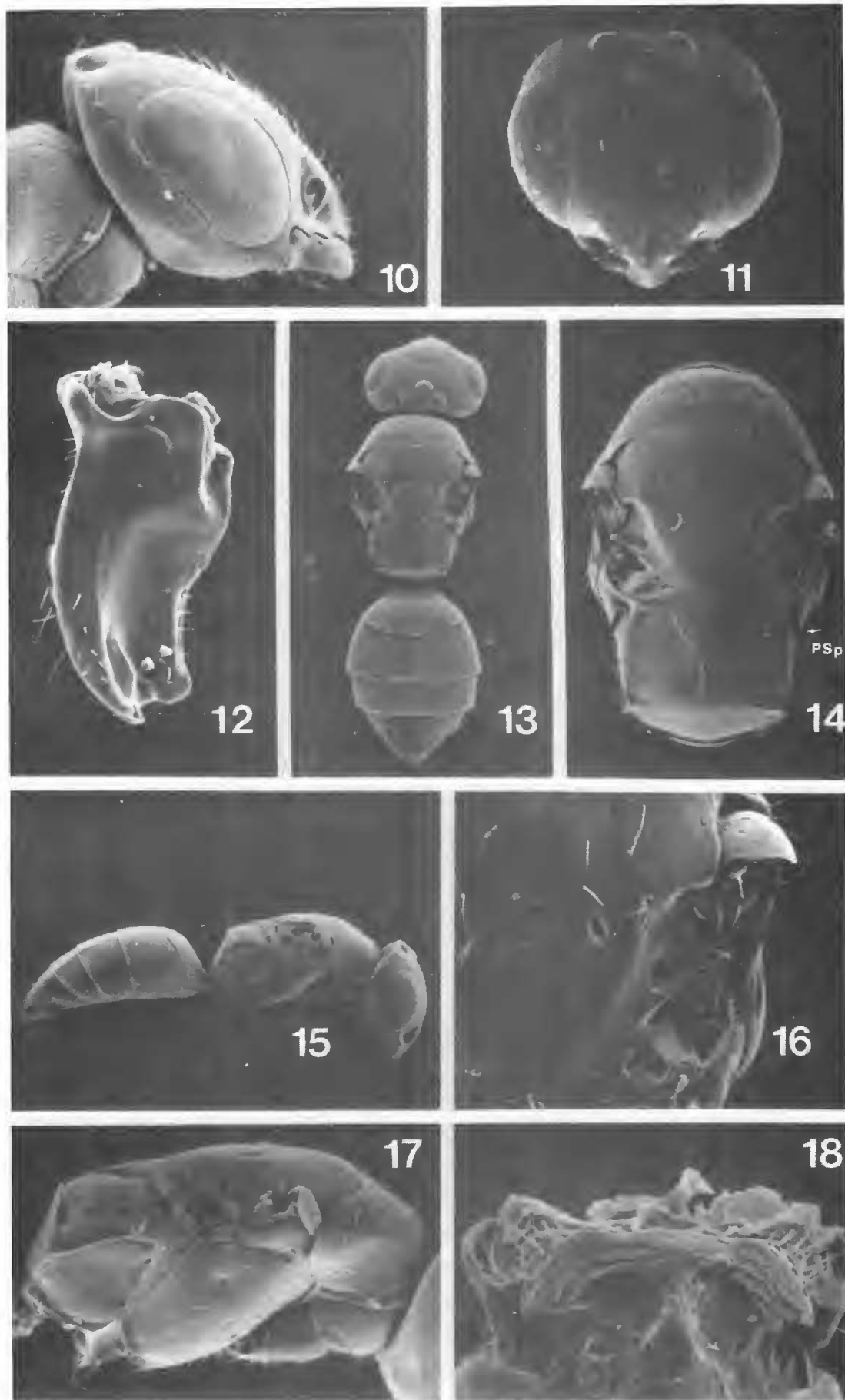


Figure 10. *Goniozus sensorius* n. sp., male head, lateral aspect (130X). Figure 11. *Goniozus sensorius* n. sp., male head, frontal aspect (100X). Figure 12. *Goniozus sensorius* n. sp., male mandible, ventromedial aspect (360X). Figure 13. *Goniozus sensorius* n. sp., male habitus, dorsal aspect (40X). Figure 14. *Goniozus sensorius* n. sp., male mesosoma, dorsal aspect (86X). (PSp. Propodeal Spiracle). Figure 15. *Goniozus sensorius* n. sp., male habitus, lateral aspect (44X). Figure 16. *Goniozus sensorius* n. sp., male mesosoma, enlargement of tegula, axillary region, scutellar pits, and metanotal pits (180X). Figure 17. *Goniozus sensorius* n. sp., male mesosoma, lateral aspect (110X). Figure 18. *Goniozus sensorius* n. sp., male petiole, ventral aspect (480X).

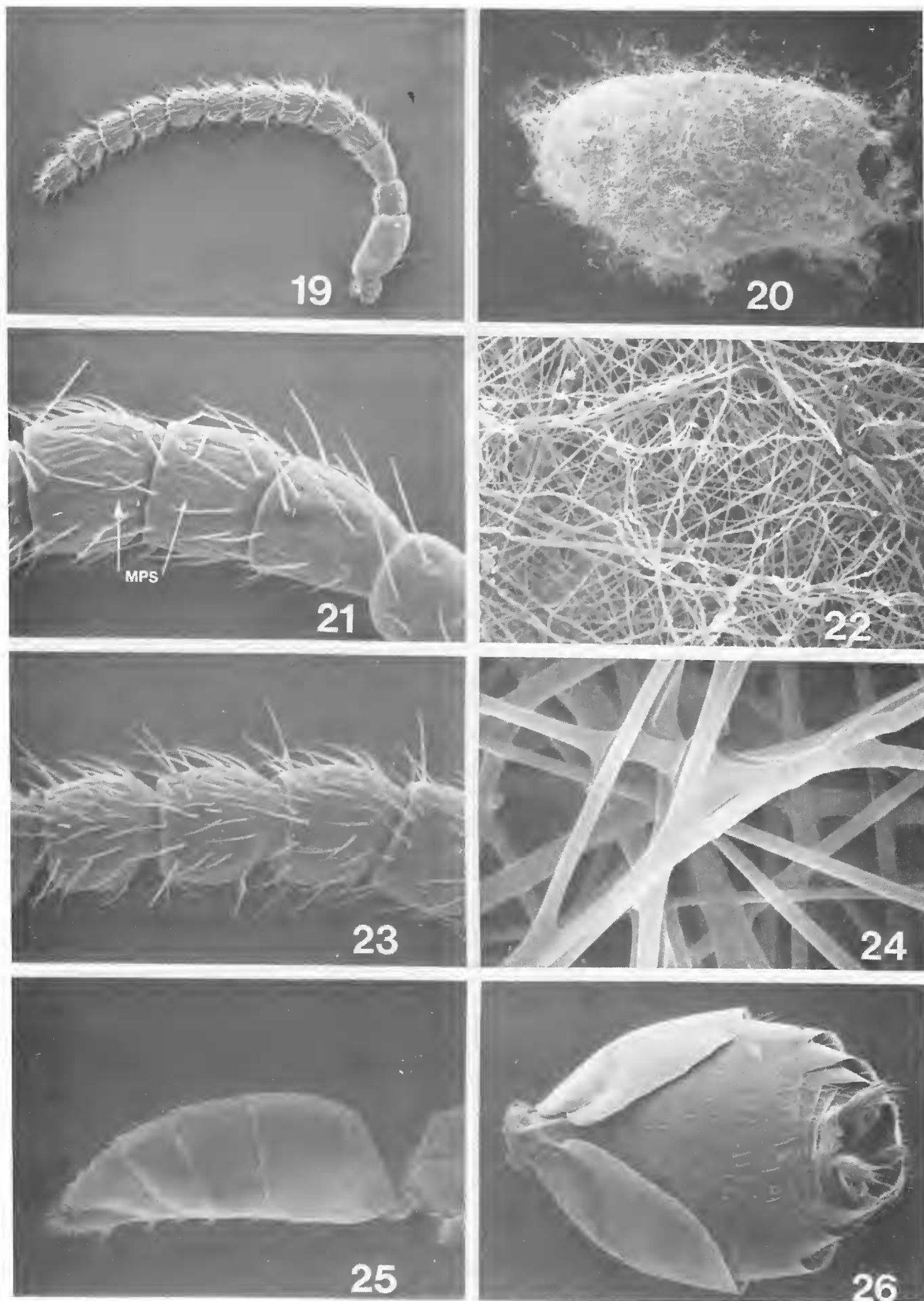


Figure 19. *Goniozus sensorius* n. sp., male antenna (150X). Figure 20. *Goniozus sensorius* n. sp., pupal cocoon (emergence hole at left) (20X). Figure 21. *Goniozus sensorius* n. sp., male antennal funicular segments 1-3 (540X). (MPS. Multiporous Plate Sensilla). Figure 22. *Goniozus sensorius* n. sp., pupal cocoon (magnification of threads) (200X). Figure 23. *Goniozus sensorius* n. sp., male antennal funicular segments 4-6 (480X). Figure 24. *Goniozus sensorius* n. sp., pupal cocoon (magnification of thread junction) (2000X). Figure 25. *Goniozus sensorius* n. sp., male metasoma, lateral aspect (78X). Figure 26. *Goniozus sensorius* n. sp., male metasoma, ventral aspect (86X).

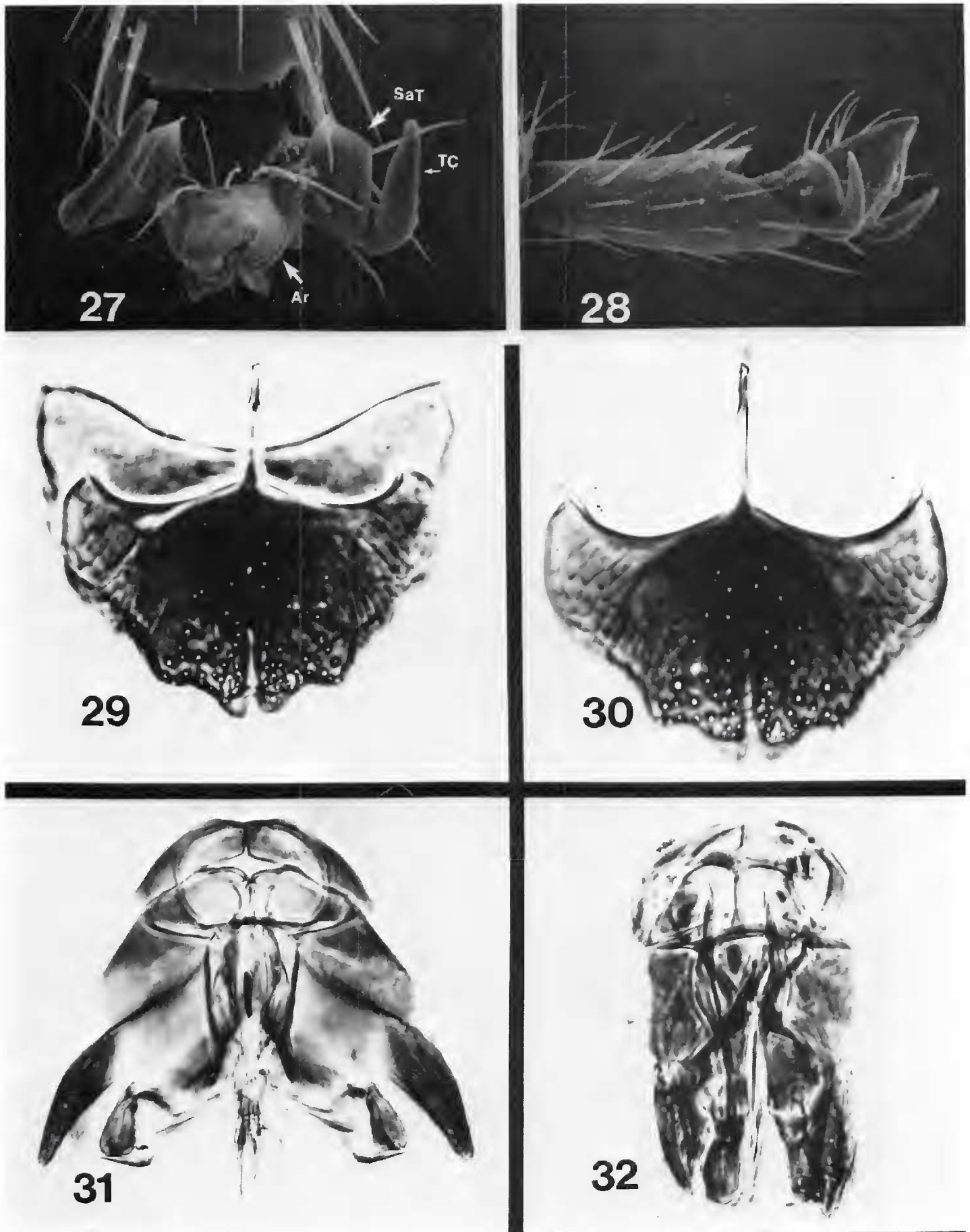


Figure 27. *Goniozus sensorius* n. sp. male hind leg pretarsus, frontal view (1000X). (Ar. Arolium; SaT. Subapical Tine. TC. Tarsal Claw). Figure 28. *Goniozus sensorius* n. sp. male hind leg pretarsus, lateral aspect (600X). Figure 29. *Goniozus sensorius* n. sp., male subgenital plate (sternum VII) and sternum VI (620X). Figure 30. *Goniozus sensorius* n. sp., male subgenital shield (sternum VII) (600X). Figure 31. *Goniozus sensorius* n. sp., male genitalia with parameters expanded (600X). Figure 32. *Goniozus sensorius* n. sp., male genitalia with parameters contracted (600X).

darker base of each femur, with the apical half yellow. All of the legs on a specimen show the same color pattern.

Male.—Body length ranges from 2.00–2.44 mm in the type-series. Some males display a flush of pale coloration behind the compound eye. The character appears correlated with a general castaneous coloration of the first and second metasomal terga, and bright yellow coloration of the legs. Such coloration differences sometimes motivated early bethylid taxonomists to propose new names, but in the present context, all of the type-material comes from a homogeneous series of lab-reared siblings.

Male *G. sensorius* are invariably smaller than conspecific females. That is, in the type-series there is no male larger than the smallest female. It is difficult to provide biometrical data on body length, the simplest measure of body size, because wasps of both sexes typically die in a flexed position.

MATERIAL EXAMINED

Holotype.—Intact, point-mounted female with collection information reading: INDIA, Padappai, Tamil Nadu, Madras; 12-1-87, Coll. C. Peter; Ex. *Diaphania indica*.

Allotype.—Intact, point-mounted male taken at the same locality as the holotype, and pin bearing identical information.

Paratypes.—73 females, 34 males lab-reared by Mr. Clement Peter at Padappai from *Diaphania indica* (Saunders) taken on *Coccinia grandis* (L.) Voight (reported as *Coccinia indica* Wight and Arnott). All specimens are point-mounted and carry the same label information as the holotype. Additionally, three female and four male specimens from this series have been dissected and mounted in Canada Balsam. Six females and five males have been dissected and mounted on SEM stubs.

Numerous supplemental specimens have been supplied by Mr. Peter and examined by me. These have not been included in the type-series although they were collected from the same host plant and pyralid host. The type-series was restricted to exclude the inclusion of sibling species, and to provide a homogeneous series for subsequent morphometric analysis specifically addressing genetic variability in type-series.

Holotype, allotype, four female and four male paratypes deposited in USNM. Two male and two female paratypes each, deposited in the following institutions: Canadian National Collection, Ottawa; American Museum of Natural History, New York; California Academy of Sciences, San Francisco; Zoological Institute, Soviet Academy of Sciences, Leningrad; South African National Insect Collection, Pretoria; Australian National Insect Collection, Canberra; Entomological Laboratories, Ehime University, Matsuyama. The remainder of the type-series is deposited in the Entomological Collections at the University of California, Riverside.

DISCUSSION

Goniozus is a cosmopolitan genus with nearly 150 nominal species. It is among the largest genera of Bethylidae, and clearly the largest genus in the Bethylinae. A world catalog has been developed which suggests all species are external parasites of Lepidoptera larvae (Gordh, unpublished).

Our knowledge of the Indian Bethylidae is limited to few studies, the most extensive by Kurian (1952, 1954a, 1954b, 1955), and a revised key prepared by Ram and Subba Rao (1967). More recent work has developed isolated descriptions of new species based on material taken in Pakistan and India (Ram 1969, Samad 1973, and Gordh 1984). Elsewhere I (Gordh, accepted) have summarized knowledge of *Goniozus* from the Indian Subcontinent and treated nomenclatural problems with *Goniozus* from India.

The species described here belongs to *Goniozus* in the restricted sense of earlier workers. Features in combination which I regard as most distinctive and diagnostic include: Pale colored mandible and coxae; head as wide as long; antenna with evanescent multiporous plate sensilla; scutellar pits not connected by a transverse sulcus; slit-like propodeal spiracles; propodeum with well-formed, polished, triangular antero-median elevation with continuous longitudinal carina to complete posterior transverse carina.

Comparing *G. sensorius* with other Indian species which may be closely related is difficult. Type-specimens are not available for study, many original descriptions lack adequate detail, and existing keys are misleading. Further, five described species are known only from the male. These males may be conspecific with females which stand under other names.

Kurian (1955) published a key to Indian *Goniozus*. This key was modified by Ram and Subba Rao (1967). The first couplet in both keys creates a dichotomy based on head width to length. *Goniozus sensorius* females display a head as wide as long. Among species with a non-elongate head, *G. sensorius* keys to *G. triangulifer* Kieffer. This species was described twice (Kieffer 1914a, 1914b) from Laguna, Los Banos, Luzon in the Philippines. The type-series cannot be located. I have identified material as such from Lae, New Guinea and Luzon. If my identification of this species is correct, then *triangulifer* has black coxae and dark femora, a comparatively long, thin longitudinal carina extending posteriad from the propodeal triangle, and the multiporous plate sensilla of the antennal funicular segments are more conspicuous. The name *triangulifer* has been comparatively frequently published in the literature (cf. Paine 1961, Paine 1964, Catley 1966). Hosts include *Cnaphalocrocis medinalis* (Guenee), *Marasima patnalis*, *Nacoleia octasema* (Meyrick), and a pyraustid leaf roller on rice.

Appendage coloration has been used to provide differentiae for species of *Goniozus*, but this is frequently an unreliable character. Coloration of the tagma and mandibles may be more reliable. Female *G. sensorius* may be distinguished from the female of *G. chatterjii* by the apparently reddish-brown abdomen (metasoma) of the latter species. Both species display a triangular elevation on the dorsal face of the propodeum which continues posteriad as a carina to the junction of the dorsal and posterior propodeal faces.

Bethylids frequently possess subapical claws, tines and setal modifications on the pretarsus of the legs. *Goniozus* females typically have "bifid" pretarsi and the males have trifid pretarsi. These features have been used taxonomically in some recent bethylid studies (vide Evans 1978; Krombein 1987), but have been generally ignored. These structures are sometimes striking or bizarre, but they have not been analyzed or carefully described in detail within *Goniozus*. The truncate subapical tine on the pretarsi of *G. sensorius* is not readily evident or appreciated with light microscopy, but it is similarly developed in the male and female. The tine appears to

develop from the unguis and not the arolium. The functional significance of this character state is not understood.

That females are invariably larger than conspecific males is a condition common among the Bethylidae, and parasitic Hymenoptera in general. The present example should provide data for morphologists interested in allometry, and biologists interested in resource allocation. Additionally, this species of *Goniozus* also skews its sex ratio in a female bias, with one to a few males produced per brood. This phenomenon has been discussed by Greene et al. (1982).

The subgenital shield (apical sternum) of male *Goniozus* must be studied comprehensively to determine its importance in the taxonomy of the genus. Many species, including *G. sensorius* exhibit a modified posterior margin. The notched surface probably serves as a guide for the intromittent portion of the aedeagus.

Features of the pupal cocoon have not been used in bethylid taxonomy, but this aspect of development is potentially rich in characters. The cocoon of *G. sensorius* is typically brown but occasionally white cocoons are produced. The difference in color probably is correlated with availability of tyrosine. The cocoon formed by *G. sensorius* is relatively tightly woven and brown (Figs. 20, 22, 24). Many species of *Goniozus* spin cocoons which are white. The significance of color is unknown, but study of the phenomenon should reveal an interesting, potentially important, aspect of the biology of these wasps. All members of a brood construct cocoons of the same color. Each individual constructs its own cocoon, but all members of a brood construct their cocoons in a compact mass with each individual contributing a few threads which bind all of the cocoons together. Each cocoon is about two times longer than wide (Fig. 20), with the strands loosely woven and of similar diameter at all levels of construction (Figs. 22, 24). Emergence by the adult is from the polar end nearest the head of the developing pupa.

LITERATURE CITED

- Catley, A. 1966. Parasites and predators of some insects recorded from the territory of Papua and New Guinea. Dept. Agric. Res. Bull. 2, 18 pp.
- Evans, H. E. 1978. The Bethylidae of America North of Mexico. Mem. Amer. Entomol. Inst. 27, 332 pp.
- Gordh, G. 1984. *Goniozus pakmanus* (Hymenoptera: Bethylidae), a new species imported into California for the biological control of pink bollworm, *Pectinophora gossypiella* (Lepidoptera: Gelechiidae). Entomol. News 95 (5):207–211.
- Gordh, G. A new species of *Goniozus* from India and taxonomic notes on related species (Hymenoptera: Bethylidae). Indian Jour. Entomol. (Accepted)
- Green, R. F. et al. 1982. Precise sex ratios in highly inbred parasitic wasps. Amer. Nat. 120:653–665.
- Kieffer, J. J. 1914a. Enumeration des serphides (Proctotrupoides) des Iles Philippines avec description de genres nouveaux et d'especes nouvelles. Philip. Jour. Sci. 9:285–311.
- Kieffer, J. J. 1914b. Diagnoses de quelques nouveau bethylides exotiques (Hym.). Bull. Soc. Entomol. Fr. 1914, p. 158.
- Krombein, K. V. 1987. Biosystematic studies of Ceylonese wasps, XVIII: The species of *Trachepyrus* Kieffer (Hymenoptera: Bethylidae: Epyrinae). Pan-Pac. Entomol. 63 (2):135–144.
- Kurian, C. 1952. Descriptions of four new and record of one known Bethyloidea (parasitic Hymenoptera) from India. Agra Univ. Jour. Res. 1:63–72.
- Kurian, C. 1954a. Catalog of Oriental Bethyloidea. Agra Univ. Jour. Res. (Sci.) 2:253–288.
- Kurian, C. 1954b. Descriptions of five new and records and redescriptions of two known Bethyloidea (parasitic Hymenoptera) from India. Agra Univ. Jour. Res. (Sci.) 3:417–439.
- Kurian, C. 1955. Bethyloidea (Hymenoptera) from India. Agra Univ. Jour. Res. 4:67–156.
- Lal, K. B. 1939. Some new species of Hymenoptera from India. Indian Jour. Entomol. 1:49–58.
- Muesebeck, C. W. F. 1940. Two new hymenopterous parasites of sugarcane borers in India. Proc. Entomol. Soc. Wash. 42: 120–122.

- Paine, R. W. 1961. Observations on the banana scab moth in the territory of Papua and New Guinea. Papua New Guinea Agric. Jour. 14:45-47.
- Paine, R. W. 1964. The banana scab moth *Nacoleia octasema* (Meyrick): its distribution, ecology and control. Tech. Paper So. Pac. Comm. 145, 65 pp.
- Pruthi, H. S. and M. S. Mani 1942. Distribution, hosts and habits of the Indian Serphoidea and Bethyloidea. Mem. Indian Mus. 13:405-444.
- Ram, A. 1969. Description of *Goniozus delhiensis* n. sp. (Bethylidae: Hymenoptera), a primary larval parasite of *Dichocrocis punctiferalis* (Guen.) (Pyralidae: Lepidoptera). Bull. Entomol. Res. 10:68-70.
- Ram, A. and B. R. Subba Rao 1967. The description of *Goniozus stomopterycis* n. sp., (Bethylidae: Hymenoptera), a primary larval parasite of *Stomopteryx nerteria* (Meyrick) in South India and a revised key to Oriental species of *Goniozus* Foerster. Bull. Entomol. Res. 8:73-78.
- Samad, K. 1973. Systematics and biology of *Goniozus rugosus*—new species (Bethylidae: Hymenoptera) a larval parasite of micro-lepidoptera in Pakistan. Agric. Pakistan 24:195-200.